**Unilateral Vestibular Hypofunction**

**Background Information**

Dizziness is one of the most common complaints adults report in the primary care setting, with increasing prevalence as individuals age.1,2 The incidence of dizziness in the United States is estimated around 5.5%.3 Vestibular dysfunction is a common source of dizziness and physical therapists are likely to encounter individuals with vestibular disorders within a variety of settings. A recent study estimated up to 35% of individuals over the age of 40 years have experienced some form of vestibular dysfunction.4 The purpose of this paper is to better understand unilateral vestibular hypofunction (UVH), a specific type of vestibular dysfunction.

**Pathophysiology**

The peripheral vestibular system has three main functions: stabilize visual images on the fovea of the retina during head movement, sustain postural stability, especially with head movement, and provide information relating to orientation in space.5 The peripheral vestibular system is composed of three semicircular canals and two otolith organs to achieve these functions.5 The semicircular canals respond to angular acceleration, whereas the two otolith organs, the saccule and utricle, respond to linear acceleration and static head tilt.5

Pathological issues with one side of these inner ear structures or the vestibular portions of the vestibulocochlear cranial nerve lead to peripheral unilateral vestibular dysfunction (UVH).6  Potential causes for UVH include vestibular neuronitis, labyrinthitis, Meniere disease, surgical procedures such as labyrinthectomy or removal of an acoustic neuroma (vestibular schwannoma), vascular issues that impact the vestibular nerve, traumatic brain injury that impacts the vestibular system, aging-related weakness, and toxicity due to medications.6-8

**Symptoms**

Patients may present with different symptoms based upon the underlying cause. We may see patients with acute or chronic UVH. With UVH, the ipsilateral side has reduced neuronal activity or firing rates.8  The brain will receive asymmetric signals due to the relative increase in firing rates of the contralateral side, and it will seem as though the head is rotating towards the unaffected ear.8  This leads to spontaneous nystagmus.8  Static deficits (the patient is still and not moving their head) typically occur for up to one week, after which the patient typically has “central compensation for the static defect”.8 This means the difference in firing rates typically equalizes. Deficits may still occur, however, in the dark and with dynamic activities for years, if not treated.8  Individuals will have issues with head movements due to decreased VOR, nystagmus after head movements, and may veer or rotate towards the effected side in the dark or when their eyes are closed.8

Acute UVH symptoms due to vestibular neuronitis (the most common cause for UVH) or labyrinthitis may include severe vertigo, nausea, vomiting, and balance/gait issues, including gait ataxia and veering toward the side of the affected ear.8,9 They may demonstrate a wide base of support, slower speed, decreased arm swing and decreased trunk rotation during gait in the acute phase.5 They are likely dizzy at rest and worse with movement.10  Vestibular neuritis is not associated with hearing loss, however, labyrinthitis is.10 Meniere’s disease is typically more episodic with vertigo, nausea, and vomiting that may last for minutes or even hours.9  Patients with Meniere’s often describe fullness in their ears, tinnitus, and hearing loss.9 Patients with more gradual onset of symptoms may be due to aging-related weakness and may not have symptoms at rest but have noticeable issues with dynamic activities like walking with head turns and difficulty walking in dark rooms or outdoors.8

Wilhelmsen and Kvale11 recently published results from a case series regarding common musculoskeletal abnormalities associated with UVH, including postural issues, restricted diaphragmatic breathing, restricted trunk movement, and tense neck and upper trunk musculature.

Depending on the type and duration of symptoms, individuals will experience various limitations in activities and participation, and individuals with chronic UVH may report reduced overall quality of life compared to others. In the acute phase patients may have trouble with ADLs such as bathing and dressing. Walking is also likely to be significantly impaired. Patients may have trouble working, caring for their family (or self), etc. Patients may have different perceptions of the impact of UVH on their life.

**Tests and Measures**

There are many objective and subjective outcome measures that can assess the impact of UVH on activities.

*Objective Measures*

Commonly used objective outcome measures that assess functional activities include the 10-Meter Walk Test, Timed Up and Go (TUG), the Dynamic Gait Index (DGI), and the Functional Gait Assessment (FGA).9,12 Therapists can use these measures to better understand the impact of UVH during important functional activities such as “normal” walking, performing turns, walking with head turns, walking backwards, ascending and descending stairs, and walking with eyes closed.9 The TUG, DGI and FGA have been tested in vestibular patient populations and are recommended for use by the Vestibular EDGE task force from the APTA.13,14

In addition to the measures mentioned above, the Vestibular EDGE also recommended the following measures as appropriate for use with the vestibular patient population: Berg Balance Scale (BBS), Clinical Test of Sensory Integration and Balance (CTSIB), BESTest and Mini-BESTest, Five Times Sit-to-Stand, Four Square Step Test, and the Sensory Organization Test.14

*Subjective Measures*

Measures that assess the patients’ perceived impact of the dizziness on their activities are also extremely important. The Dizziness Handicap Inventory (DHI) is a commonly used tool that measures the patient’s perception of handicap secondary to their dizziness on 25 different items and was recommended by the Vestibular EDGE.9,14,15 Questions pertain to functional, emotional, and physical domains.5 The DHI measures the patient’s perception of dysequilibrium and its impact on daily activities.5

Although the Activities of Balance Confidence (ABC) is not specific to vestibular populations, it is a great tool to measure balance confidence, which is commonly lower in populations with vestibular issues.15 Again, this measure was recommended by the Vestibular EDGE.14

The Vestibular Activities of Daily Living Scale (VADL) helps to identify which ADLs the patients have trouble with secondary to dizziness.15 The VADL consists of 28 questions that address 3 subscales: functional, ambulatory, and instrumental.13 Therapists should note there are limited psychometric properties reported for VADL.13 The Vestibular Activities and Participation Measure (VAP) is a newer measure that consists of 34 questions related to activities and participation based on the ICF model.13 Similar to VADL, there are limited psychometric properties reported for VAP.13

The Visual Analogue Scale (VAS) can obtain subjective reports of the intensity of the patient’s vertigo, disequilibrium, and oscillopsia.5

All of these subjective measures may highlight the potential anxiety patients have secondary to their vestibular issues. Anxiety and/or depression may be associated with vestibular issues and can significantly impact their prognosis for rehabilitation. In one study12, researchers asked the specific question: “What percentage of the time has dizziness interfered with your activities?” The researchers12 called this the Percentage of time Symptoms Interfere with Life (PSIL) and stated the clinically meaningful change has not been identified, however, “significant change” is considered at least 4.1%.12

The researchers12 found individuals with UVH who had higher PSIL and the presence of anxiety and/or depression typically had higher scores of PSIL at discharge, even after a vestibular rehabilitation program. Therapists should acknowledge the potential presence and impact of psychological issues on prognosis during vestibular therapy and consider referrals, if necessary. A tool to help identify the impact of anxiety is the Vertigo Symptom Scale (VSS).15 It helps to “assess and differentiate symptoms of balance disorder, and somatic anxiety and autonomic arousal”.13

**Interventions**

Habituation exercises are common in vestibular rehabilitation (VR) for those with UVH. The concept of habituation exercises is to reduce unwanted responses with repeated stimuli/movement.5 Clendaniel16 conducted a small, 6-week study assessing results of habituation and gaze stability (i.e. adaptation) exercises for those with UVH. The habituation exercises included “large amplitude, rapid cervical rotation” (horizontal or vertical) while seated initially. Progression included performing these while standing and pivoting, and also while seated and performing simultaneous trunk flexion/extension exercises. The final week included Brandt-Daroff exercise in addition to the cervical rotation exercises. Clendaniel16 altered the number of repetitions and sets to progress the exercises throughout the study as well. Generally, therapists may begin habituation exercises for VR by incorporating the provoking exercise for 30 seconds, three to five times each.5 The patient should practice these provoking exercises two to three times per day.5

Gaze stability exercises (i.e. adaptation exercises) are another common intervention for UVH. These exercises improve the VOR and other systems that assist in gaze stability with head movement.5 The Clendaniel study16 consisted of VOR x1 exercises (both horizontal and vertical) while seated for 1 minute. This was progressed by increasing the duration, performing the task while standing, adding busy backgrounds with near and far targets, and eventually VOR x2 while standing with busy background for longer duration. Clendaniel16 found positive results from both types of exercises for those with UVH. Unfortunately, due to the small sample size, between group differences could not be calculated.

Balance and gait exercises are also important in VR for UVH.17,18 These may consist of static balance on various surfaces and different bases of support, eyes open and eyes closed, gait with horizontal and vertical head turns, incorporating dual-task activities such as walking with head turns but also counting backwards, and gait with eyes closed.18

The frequency and intensity of interventions is a critical component in the patient’s plan of care (POC). As expected, frequency and intensity will vary per person. VR can be 2-3 times per week or once every 2-3 weeks, for a total of a couple weeks or several months.19 The actual session may be around 45 minutes to one hour.19 The intensity of the vestibular rehabilitation will depend on the patient’s tolerance to the activities. It’s recommended the therapist and patient should discuss a “maximum dizziness rating” the patient will handle prior to ceasing the session.19 Therapists should incorporate different head frequencies and velocities to simulate the different type of stimuli that may occur during a typical day so that the vestibular system can adapt.17  Also, the therapist should try to prevent rehabilitation from making the patient dizzy for greater than 20 minutes after the end of the session.19

Therapists should consider addressing the musculoskeletal issues that may be related to UVH, as discussed by Wilhelmsen and Kvale11. In their study11, they addressed musculoskeletal issues with a modified vestibular rehabilitation program that included body awareness exercises. The authors11 reported improvements in mobility, self-reports of symptoms and disability, and relaxation of the upper trunk and respiration.

Gabilan et al20 studied the effects of aquatic therapy to treat individuals with UVH. They did not perform VR simultaneously. The aquatic therapy sessions consisted of a specific protocol that included 12 phases with a focus on balance adjustments in the water, motor activities that required postural stability, and gait with eyes closed and repetitive head movements. Gabilan et al20 identified significant improvements in quality of life, balance, and self-perception of dizziness intensity with this rehabilitation method. Further studies comparing aquatic therapy to the common habituation and adaptation exercises should be investigated. Aquatic therapy could be a great intervention for those individuals who do demonstrate high anxiety and stress associated with UVH, along with providing a safer environment to challenge the patient’s balance abilities.

**Conclusions**

Many items were reviewed in this paper pertaining to unilateral vestibular hypofunction, including the pathophysiology, symptoms, recommended outcome measures, and interventions. Peripheral UVH may impact individuals’ activities, participation, and quality of life differently depending on the type and duration of their symptoms, which are associated with the different pathologies that cause UVH. A therapist may utilize the APTA Guide to Physical Therapy Practice for information that may assist them in examining and treating patients with UVH. The relevant Practice Patterns21 for UVH include:

Pattern 5A: Primary Prevention/Risk Reduction for Loss of Balance and Falling

Pattern 5F: Impaired Peripheral Nerve Integrity and Muscle Performance Associated With Peripheral Nerve Injury

References:

1. Sloane, PD, et al: Dizziness: State of the science. Ann Intern Med 134:823, 2001.

2. Kroenke, K, et al: How common are various causes of dizziness? A critical review. South Med J 93:160, 2000.

3. Kroenke, K, and Mangelsdorff, AD: Common symptoms in ambulatory care: Incidence, evaluation, therapy, and outcome. Am J Med 86(3):262,1989.

4. Agrawal Y, Carey JP, Della Santina CC, Schubert MC, Minor LB. Disorders of balance and vestibular function in US adults. Arch Intern Med. 2009;169(10): 938-944

5. O’Sullivan S. & Schmitz T. Traumatic spinal cord injury. *Physical Rehabilitation: Assessment and Treatment.* 4th ed. 2001. F.A. Davis Company. Philadelphia, PA. p999-1026.

6. Farrell, L. APTA Section on Neurology Fact Sheet: Peripheral versus Central Vestibular Disorders. <http://www.neuropt.org/docs/vsig-physician-fact-sheets/peripheral-vs-central-vestibular-disorders.pdf?sfvrsn=2>. Accessed 3/26/14.

7. Brown, L. APTA Section on Neurology Fact Sheet: Unilateral Vestibular Hypofunction. <http://www.neuropt.org/docs/vsig-english-pt-fact-sheets/unilateral-vestibular-hypofunction.pdf?sfvrsn=2>. Accessed 3/26/14.

8. Cabrera Kang CM, Tusa RJ. Vestibular rehabilitation: Rationale and indications. Semin Neurol. 2013;33(3):276-285.

9. Alghadir AH, Iqbal ZA, Whitney SL. An update on vestibular physical therapy. J Chin Med Assoc. 2013;76(1):1-8.

10. Campeau M, Grove C, Smith B, Van Heuklon N. Evaluating and Treating Patients with Vestibular Syndromes in Acute Settings. Presented at Combined Sections Meeting February 3-6, 2014.

11. Wilhelmsen K, Kvale A. Individuals with unilateral vestibular damage--examination and treatment with focus on the musculoskeletal system: A case series. Phys Ther. 2014

12. Herdman S, Hall C, Delaune W. Variables Associated With Outcome in Patients With Unilateral Vestibular Hypofunction. Neurorehabilitation & Neural Repair [serial online]. February 2012;26(2):151-162.

13. Rehabilitation Measures Database: Vestibular Disorders. <http://www.rehabmeasures.org/default.aspx>. Accessed 3/26/14.

14. PT Now Functional Limitation Reporting Under Medicare: Tests and Measures for High-Volume Conditions: Vestibular EDGE. <http://www.ptnow.org/FunctionalLimitationReporting/TestsMeasures/Default.aspx>. Accessed 3/26/14.

15. Eleftheriadou A, Skalidi N, Velegrakis GA. Vestibular rehabilitation strategies and factors that affect the outcome. Eur Arch Otorhinolaryngol. 2012;269(11):2309-2316.

16. Clendaniel RA. The effects of habituation and gaze stability exercises in the treatment of unilateral vestibular hypofunction: A preliminary results. J Neurol Phys Ther. 2010;34(2):111-116.

17. Schubert MC, Minor LB. Vestibulo-ocular physiology underlying vestibular hypofunction. Phys Ther. 2004;84(4):373-385.

18. Hall CD, Schubert MC, Herdman SJ. Prediction of fall risk reduction as measured by dynamic gait index in individuals with unilateral vestibular hypofunction. Otol Neurotol. 2004;25(5):746-751.

19. Whitney SL, Sparto PJ. Principles of vestibular physical therapy rehabilitation. NeuroRehabilitation. 2011;29(2):157-166.

20. Gabilan YP, Perracini MR, Munhoz MS, Gananc FF. Aquatic physiotherapy for vestibular rehabilitation in patients with unilateral vestibular hypofunction: Exploratory prospective study. J Vestib Res. 2008;18(2-3):139-146.

21. Guide to Physical Therapist Practice: Preferred Physical Therapist Practice Patterns. <http://guidetoptpractice.apta.org/content/current>. Accessed 3/26/14.